

STATE OF CALIFORNIA

Specification for Thermoplastic Traffic Striping Material, Hydrocarbon Binder, White, Yellow and Lead-Free Yellow

1.0 SCOPE

This specification covers a reflectorized thermoplastic pavement striping material that is applied to Portland cement concrete or asphalt concrete road surfaces in a molten state by a mechanical applicator. While still hot, reflectorizing glass beads are applied to the surface of the applied thermoplastic striping. Upon cooling to normal pavement temperatures this produces a durable, adherent, retroreflective stripe that is capable of resisting deformation by traffic.

2.0 APPLICABLE SPECIFICATIONS

The following specifications, test methods and standards in effect on the opening date of the Invitation for Bid form a part of this specification where referenced.

California Test Methods; No. 423 and No. 660 (latest revision).

California Department of Transportation, Standard Specifications, July 1999.

Federal Standard Designation: No. 595b, color #33538.

American Association of State Highway and Transportation Officials, AASHTO Designation: M 247 and AASHTO Designation: T 250.

American Society for Testing and Materials, ASTM Designations; D 476, D 2794, D 4563, D 4764, D 5381, E 11, E 28 and G 53.

Commission International de l'Eclairage (C.I.E.) 1931 Chromaticity Diagram.

California Code of Regulations: Title 22.

3.0 REQUIREMENTS

3.1 Composition:

The thermoplastic material shall be composed of 100% solids. The binder shall consist of synthetic hydrocarbon thermoplastic resins and shall be homogeneously blended with all necessary pigments, fillers, glass beads and additives to produce a traffic striping material to meet the requirements as specified herein.

The Yellow material shall contain heat-resistant, silica-encapsulated lead chromate as the prime pigment. The Lead-Free (L/F) Yellow material shall not contain lead or other toxic metals. When tested according to California Code of Regulations, Title 22, Division 4.5, Chapter 11,

Article 5, section 66261.126 - Appendix II (California Waste Extraction Test), all materials shall have an extractable lead content of less than 0.3 mg per liter.

3.2 Form:

The thermoplastic material shall be supplied in either block or granular form as requested in the purchase order.

3.3 Application Type:

Two viscosity grades of thermoplastic material shall be available for purchase; Extruded-Viscosity and Low-Viscosity. Extruded-Viscosity grade is more suitable for screed type applicators, while Low-Viscosity grade material is commonly used with ribbon or spray type applicators. The thermoplastic material shall be formulated to meet the viscosity grade specified in the purchase order.

3.4 Characteristics of the Finished Thermoplastic:

Use **California Test Method No. 423 (CTM 423)** unless otherwise specified.

		<u>White</u>	<u>Yellow</u>	<u>L/F Yellow</u>
3.4.1	Glass Beads, intermixed, AASHTO Designation: M 247 Type I, percent by weight.	25-35	25-35	25-35
3.4.2	Binder, percent by weight, minimum.	18	18	18
3.4.3	Inert Fillers, insoluble in hydrochloric acid, percent by weight passing a sieve with openings of 150µm, ASTM Designation: E 11.	100	100	100
3.4.4	Titanium Dioxide (Rutile) Pigment meeting ASTM Designation D476 type II, analyze titanium dioxide content using ASTM Designation: D 4563 or D4764, percent by weight, minimum.	10	-	-
3.4.5	Lead Chromate Pigment, heat-resistant, silica-encapsulated type containing 60% PbCrO ₄ (minimum). Analyze Pb and Cr content using ASTM Designation: D 5381, percent by weight, minimum. (Note: extractable lead level in unmelted thermoplastic must meet section 3.1 above)	-	3%	<100 mg/kg (total lead)
3.4.6	Specific Gravity, maximum.	2.15	2.15	2.15
3.4.7	Ring and Ball Softening Point, minimum	93-121°C	93-121°C	93-121°C

CTM 423 (Part VI), ASTM Designation: E 28.

- 3.4.8 **Perform the remaining tests on the material after 4 hours heating** with stirring at $218^{\circ}\text{C} \pm 2^{\circ}\text{C}$, which includes 1 hour for meltdown and temperature stabilization.

	<u>White</u>	<u>Yellow</u>	<u>L/F Yellow</u>
3.4.8.1 Tensile Bond Strength to an unprimed abrasive blasted Portland cement concrete brick, 3.2 mm thick film draw down at 218°C , tested at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, MPa, minimum, CTM 423 (Part VII).	1.24 MPa	1.24 Mpa	1.24 MPa
3.4.8.2 Brookfield Thermosel Viscosity, Spindle SC4-27, 20 rpm at 218°C , Pa•s, CTM 423 (Part VIII).			
Low-Viscosity Grade - - - - -	<3	<3	<3
Extrude-Viscosity Grade - - - - -	4.5 to 10	4.5 to 10	4.5 to 10
3.4.8.3 Impact Resistance, 3.2 mm thick film draw down at 218°C on an unprimed abrasive blasted Portland cement concrete brick, male indenter 15.9 mm diameter, no female die. Test at $25^{\circ}\text{C} \pm 2^{\circ}\text{C}$, kilogram force•meter, with no cracks or bond loss, minimum CTM 423 (Part IX), ASTM Designation D 2794.	0.58	0.58	0.58
3.4.8.4 Daylight Luminous Reflectance CTM 423 (Part XI).	80 Minimum	45 to 59	45 to 59
3.4.8.5 Yellow Color, shall match Federal Standard Designation: No. 595b, color #33538 and shall lie within the following chromaticity limits “box” defined by plotting the following four (x,y) pairs on a C.I.E. 1931 Chromaticity diagram; (x1,y1) = (0.5125, 0.4866) (x2,y2) = (0.4760, 0.4557) (x3,y3) = (0.4881, 0.4332) (x4,y4) = (0.5348, 0.4646) Brightness(Y) shall be from 45 to 59, Measurement conditions = 2° /illuminant “C”, Tested according to CTM 423 (Part X) and CTM 660.	---	Pass	Pass
3.4.8.6 Yellowness Index, calculated as $\text{YI} = 100(\text{A}-\text{B})/\text{G}$, maximum CTM 423 (Part XI).	10	---	---

	<u>White</u>	<u>Yellow</u>	<u>L/F Yellow</u>
3.4.8.7 Ultraviolet Light and Condensation Exposure, 300 hours total: alternate 4 hours UV exposure at 60°C, followed by 4 hours condensate exposure at 40°C. Type FS-40 (UV-B) bulbs are used at an irradiance level of 0.47 watts per square meter at 310 nm., as measured at the sample surface during the UV cycle. Material must meet the color stability requirements below after exposure. CTM 423 (Part XIII), ASTM Designation: G 53.			
White - Yellowness Index, maximum	20	---	---
Yellow - Must meet chromaticity limits as specified in 3.4.8.5	---	Pass	Pass
3.4.8.8 Hardness, Shore A-2 Durometer with 2 kg weight, at 46.1°C, CTM 423 (Part XII) except condition sample for 2 hrs. in a 46.1°C water bath before measuring hardness. Remove the sample from the water bath and measure the hardness immediately.	45 to 75	45 to 75	45 to 75
3.4.8.9 Abrasion Test Use 400 g of graded glass beads between 600 and 850 µm diameter and an air pressure of 152 kPa to sandblast the sample in 4 different areas according to CTM 423 (Part XIV), total weight loss, grams, maximum.	10	10	10

3.5 **Other Requirements:**

3.5.1 Applicability

The molten thermoplastic material shall be readily applied at temperatures between 204°C - 232°C. The working properties of the material shall be satisfactory. Upon application to the pavement, the thermoplastic material shall be sufficiently tack-free to carry traffic; in not more than 2 minutes when the pavement surface temperature is 16°C, and in not more than 10 minutes when the pavement surface temperature is 54°C. Applying the material when pavement temperatures are outside of the 16°C to 54°C range is not recommended.

3.6 **Workmanship:**

The resins, pigments, glass beads, fillers and additives shall be homogeneously blended. The finished product shall be uniform from bag to bag. The material shall be free from all; dirt, water, foreign matter, and other deleterious substances, and shall be of such composition that it will not bleed, stain, or discolor when applied to pavements.

3.7 Shelf Life:

The material shall maintain the requirements of this specification for a minimum period of one year. Any materials failing to do so shall be replaced at the expense of the manufacturer.

3.8 Air Pollution Compliance:

This material shall comply with all applicable air pollution control rules and regulations. The thermoplastic material shall not emit fumes that are toxic or injurious to persons or property when it is heated to application temperature. The material shall not emit excessive smoke during heating or application.

3.9 Material Safety Data Sheets:

Material Safety Data Sheets shall be provided by the manufacturer to include health hazard information on the material when it is heated to application temperature.

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Sampling and Inspection:

The minimum size batch of thermoplastic traffic striping material sampled and tested shall not be less than 900 kg unless the total order is less than this amount.

All thermoplastic material intended for use by the State of California must be sampled, tested and approved by the Office of Materials and Foundations before shipment. Manufacturers within the State of California must contact the Caltrans; Sacramento, Emeryville, or Los Angeles Inspection Office for current sampling procedures. The State of California reserves the right to take random samples of lots of thermoplastic material proposed for use on California State Highways.

Manufacturers outside the State of California must submit the following information, along with two representative 6 kg samples of each lot for testing. The manufacturer will be notified of the test results and lots of material that meet this specification can then be shipped.

1. State Specification number (#8010-01B).
2. Color; white, yellow or Lead-Free Yellow, and kg of each.
3. Form; block or granular.
4. Binder Type (hydrocarbon or alkyd).
5. Exact destination address of shipment.
6. Number and identification of batches comprising shipment.
7. Date of manufacture.
8. Purchase order or contract number.

The above information is to be sent to:

Office of Materials and Foundations
Structural Materials Branch, Inspection Section
5900 Folsom Boulevard
Sacramento, CA 95819

On delivery, the thermoplastic may be sampled again for compliance to specification. Material not meeting the specification shall be removed and replaced by the manufacturer at their expense, including all costs for handling, testing, and shipping.

4.2 Testing:

All tests shall be performed according to the specified test methods, latest revision. Qualitative and quantitative analysis may also be performed by other methods of analysis, at the option of the California Department of Transportation. The manufacturer shall maintain a laboratory sufficiently staffed and equipped so as to maintain the quality of the product as called for in these specifications.

5.0 PREPARATION FOR DELIVERY

5.1 Packaging:

5.1.1 Block Form:

The thermoplastic material shall be packaged in suitable containers to which it will not adhere nor interact during shipment and storage. The blocks of cast thermoplastic material shall be approximately 900 by 300 by 50 mm and shall weigh approximately 22.7 kg. The containers shall be palletized as specified in the contract or purchase order.

5.1.2 Granular Form:

The thermoplastic material shall be packaged in meltable bags which are compatible with the thermoplastic and which weigh approximately 22.7 kg when filled. The containers must have sufficient strength and be properly sealed to prevent breakage and leakage during normal handling. The bags shall be shrink-wrapped to reduce shifting of the bags on the pallet and shall be palletized as specified in the contract or purchase order.

5.2 Markings:

Each individual unit/container of product shall be labeled. This label shall include: State Specification number (#8010-01B), color, type of binder, manufacturer's name and address, date of manufacture and batch number. Lead-free yellow materials shall be marked "Lead-Free". All markings on containers shall be legible and permanent. Markings shall not smear or rub off container. Containers failing to meet marking requirements will not be accepted.

The containers and labeling shall meet all applicable US Department of Transportation and Interstate Commerce Commission regulations. Concerning the content, each container shall be labeled with such warnings or precautions as are required by Local, State and Federal laws and requirements.

6.0 NOTES

6.1 Certificates of Compliance:

The manufacturer of thermoplastic materials shall furnish the Engineer with a Certificate of Compliance in conformance with the provisions of the California Department of Transportation Standard Specifications, July 1999, section 6-1.07, "Certificate of Compliance." The Certificate shall also include a list, by title and section, of all applicable State and Federal packaging and labeling laws and a statement that all requirements have been met.

Certificates of Compliance shall be sent to:

Office of Materials and Foundations
Structural Materials Branch, Inspection Section
5900 Folsom Boulevard
Sacramento, CA 95819

6.2 Patents:

The Contractor shall assume all costs arising from the use of patented; materials, equipment, devices or processes used on or incorporated in the work, and further agrees to indemnify and save harmless the State of California and its duly authorized representatives from all suits at law or action of every nature for or on account of the use of any patented; materials, equipment, devices or processes.